

## METRIC

MIL-PRF-27402C  
01 October 1997  
Superseding  
MIL-P-27402B  
27 May 1969

PERFORMANCE SPECIFICATION  
PROPELLANT, HYDRAZINE - uns-DIMETHYLHYDRAZINE  
(50% N<sub>2</sub>H<sub>4</sub> - 50% UDMH)

This specification is approved for use by all  
Departments and Agencies of the Department of Defense

1. SCOPE

1.1 Scope. This specification covers the requirements for hydrazine - uns-dimethylhydrazine (N<sub>2</sub>H<sub>4</sub> - UDMH) propellant.

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3 and 4 of this specification. This section does not include documents in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements documents cited in sections 3 and 4 of this specification, whether or not they are listed.

2.2 Government documents.

2.2.1 Specifications, standards, and handbooks. The following specifications form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DoDISS) and supplement thereto, cited in the solicitation (see 6.2).

SPECIFICATIONS

DEPARTMENT OF DEFENSE

MIL-PRF-25604	- Propellant, uns-Dimethylhydrazine
MIL-PRF-26536	- Propellant, Hydrazine
MIL-PRF-27401	- Propellant Pressurizing Agent, Nitrogen
MIL-PRF-27407	- Propellant Pressurizing Agent, Helium

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Code (68) SA-ALC/SFSP, 1014 Billy Mitchell Blvd/STE 1, Kelly AFB TX 78241-5603, by using the standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A

FSC 9135

DISTRIBUTION STATEMENT A. Approved for public release; distribution is unlimited.

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(Unless otherwise indicated, copies of the above specifications, and standards are available from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia PA 19111-5094).

2.3 Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents which are DoD adopted are those listed in the issue of the DoDISS cited in the solicitation. Unless otherwise specified, the issues of documents not listed in the DoDISS are the issues of the documents cited in the solicitation (see 6.2).

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

- ASTM D 2276 - Test Method for Particulate Contaminant in Aviation Fuel by Line Sampling (DoD adopted)
- ASTM E 29 - Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications (DoD adopted)

(Application for copies should be addressed to the American Society for Testing and Materials, 1916 Race Street, Philadelphia PA 19103-1187.)

2.4 Order of precedence. In the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

## 3. REQUIREMENTS

3.1 Chemical and physical properties. The propellants, hydrazine conforming to MIL-P-26536 and uns-dimethylhydrazine conforming to MIL-P-25604, shall be used in this propellant mixture. The chemical and physical properties of the propellant mixture shall conform to those listed in table I when tested according to the applicable test methods.

3.2 Limiting values. The following applies to all specified limits in this specification: For purposes of determining conformance with these requirements, an observed value or a calculated value shall be rounded off "to the nearest unit" in the last right-hand digit used in expressing the specification limit according to the rounding-off method of ASTM Practice E 29 for using Significant Digits in Test Data to Determine Conformance with Specifications.

3.3 Filter. A filter with a 10-micrometer nominal and 40-micrometer absolute rating shall be installed between the manufacturer's plant system and the container to be filled for delivery.

3.4 Qualitative. The propellant shall be colorless, homogeneous liquid when examined visually by transmitted light.

## 4. VERIFICATION

4.1 Classification of inspections. The inspections shall be classified as quality conformance inspections.

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4.2 Quality conformance inspection. Unless otherwise specified (6.2), each filled shipping container shall be considered a lot and shall be sampled. Each sample shall be subjected to the visual examination described in 4.3.1 for conformance to 3.4 and to the tests described in Table I for conformance to the requirements specified in Table I.

TABLE I. Chemical and physical properties.

Properties	Limits	Test Paragraph
Hydrazine (percent by weight)	51 ± 0.8	4.3.2
UDMH (percent by weight)	47 min	4.3.2
Water (percent by weight)	1.8 max	4.3.2
Total hydrazine, UDMH, and amines (percent by weight)	98.2 min	4.3.2
Particulate (milligrams per liter)	10 max	4.3.3

4.2.1 Sample. A sample consists of not less than 600 mL of propellant. Unless otherwise specified, quality conformance tests shall be made on the sample of propellant taken directly from the shipping container. When required, the sample shall be forwarded to a laboratory designated by the procuring activity for subjection to the quality conformance tests specified herein. The bottle intended for sampling shall be specially cleaned and handled according to the procedure described in 4.3.3

4.2.2 Rejection. When any sample of the propellant tested in accordance with 4.3 fails to conform to the requirements specified herein, the entire lot represented by the sample shall be rejected.

4.3 Test methods.

4.3.1 Examination of product. The propellant shall be visually examined while performing test specified in 4.3.3 to determine compliance with the requirement as specified herein. Examination to ensure that the material conforms to 3.4 shall be conducted after the sample has been transferred to the 500 mL graduated cylinder.

4.3.2 Hydrazine - uns-dimethylhydrazine assay and water. The propellant and water content of the sample shall be determined by the following method.

4.3.2.1 Gas chromatographic method.

4.3.2.1.1 Gas chromatographic column. The column to be used for this analysis is the J&W Scientific fused silica megabore column with a liquid phase of Durabond Wax.

4.3.2.1.2 Gas chromatographic parameters. Suggested experimental parameters for analysis are as follows:

Column dimensions                      30 m x 0.518 m

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Sample size	1 $\mu$ L
Carrier gas	helium
Carrier gas flow rate	8 mL/min
Initial column temperature	60°C (140°F)
Isothermal hold time	4 min
Gradient heating rate	10°C/min (18°F/min)
Final temperature	140°C (284°F)
Final isothermal hold time	2 min

Condition the column with an injection of a 1  $\mu$ L sample before beginning the analysis. The heating rate and final temperature should be adjusted so that aniline is completely eluted from the column before the end of the analysis. The analyst may vary the temperature, flow rate, column size, and sample size to optimize the procedure.

4.3.2.1.3 Calculations.

$$\%UDMH = \frac{A_{UDMH} K_{UDMH}}{\sum A_i K_i} \times 100$$

$$\%N_2H_4 = \frac{A_{N_2H_4}}{\sum A_i K_i} \times 100$$

$$\%H_2O = \frac{A_{H_2O} K_{H_2O}}{\sum A_i K_i} \times 100$$

where

$K_{UDMH}, K_{H_2O}$  = the normalization factors for UDMH and  $H_2O$ .  
 $A_{UDMH}, A_{N_2H_4}, A_{H_2O}$  = the measured areas of the UDMH,  $N_2H_4$ , and  $H_2O$  peaks multiplied by their signal attenuation factors.  
 $\sum A_i K_i$  = the sum of all the measured peak areas in the chromatogram multiplied by their respective signal attenuation factors and normalization factors.

Assumptions: The normalization factor for  $N_2H_4 = 1.000$ . The normalization factors for trace volatile impurities =  $K_{UDMH}$ .

4.3.2.1.4 Calibration procedure. Obtain the normalization factors for each component by observing the areas produced by a specially prepared mixture, designated the reference standard. Prepare the standard with freshly distilled components assayed by the gas chromatographic procedure of their respective specifications; for example,  $N_2H_4$  MIL-P-26536 and UDMH MIL-P-25604. The composition of the mixture should be approximately 51 percent  $N_2H_4$ , 48 percent UDMH, and one percent  $H_2O$ . Weigh each component to 0.1 milligram. The order of addition in the standard preparation shall be  $N_2H_4$ ,  $H_2O$ , and finally UDMH. Calculate the actual composition as follows:

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$$\%UDMH = \frac{W_{UDMH} \times \text{assay}_{UDMH}}{\text{total weight}}$$

$$\%N_2H_4 = \frac{W_{N_2H_4} \times \text{assay}_{N_2H_4}}{\text{total weight}}$$

$$\%H_2O = \frac{(W_{H_2O} \times 100) + (W_{N_2H_4} \times \%H_2O) + (W_{UDMH} \times \%H_2O)}{\text{total weight}}$$

where

$W_{N_2H_4}, W_{UDMH}, W_{H_2O}$  = the weight of each component.

$W_{N_2H_4} \times \%H_2O$  = the weight of  $N_2H_4$  times the percent  $H_2O$  determined in the assay as per MIL-P-26536.

$W_{UDMH} \times \%H_2O$  = the weight of UDMH times the percent  $H_2O$  determined in the assay as per MIL-P-25604.

Analyze the referenced standard in according to 4.3.2.1.2. Calculate the normalization factors as follows:

$$K_{UDMH} = \frac{\%UDMH \times A_{N_2H_4}}{\%N_2H_4 \times A_{UDMH}}$$

$$K_{H_2O} = \frac{\%H_2O \times A_{N_2H_4}}{\%N_2H_4 \times A_{H_2O}}$$

where

$K_{H_2O}, K_{UDMH}$  = the normalization factors for  $H_2O$  and UDMH.

$A_{N_2H_4}, A_{UDMH}, A_{H_2O}$  = the measured areas of the  $N_2H_4$ , UDMH, and  $H_2O$  peaks multiplied by their signal attenuation factors.

4.3.2.2 Equipment. The following equipment shall apply as test conditions of 4.3.2.

- a. Gas chromatograph - incorporating a thermal conductivity detector.
- b. Recorder - potentiometric strip chart, 0 - 1 millivolt, 1 second FS response, with integrator.
- c. Column - J&W Scientific fused silica megabore column with a liquid phase of Durabond Wax.
- d. Hypodermic syringe - 1 microliter, fixed needle.

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e. Regulator - helium, to fit the cylinder.

4.3.3 Particulate. The propellant sample shall be tested for contamination in accordance with ASTM D-2276, Method A, with the following exceptions:

4.3.3.1 Mix the sample thoroughly by shaking the sample container. Immediately pour 500 mL of the sample into a clean 500-mL graduated cylinder. Use this 500 mL of propellant for the particulate analysis.

4.3.3.2 Use a solvent resistant filter disc made from such materials as Millipore, LSWP-04700 (Mitex-Teflon), Millipore URWP 04700 (Solvinert), or Gelman VF-6, (Fluoride-Metricel); plain, white, 10±3 microns, 47 mm diameter, or equivalent instead of that specified in ASTM D-2276.

4.3.3.3 The drying oven temperature shall be 70°C (158°F) instead of the 90°C (194°F) specified in ASTM D-2276.

4.3.3.4 Filtered isopropyl alcohol shall be used for rinsing the sample bottle and filter holder instead of petroleum ether specified in ASTM D-2276.

## 5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When actual packaging of materiel is to be performed by DoD personnel, these personnel need to contact the responsible packaging activity to ascertain requisite packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activity within the Military Department or Defense Agency, or within the Military Department's System Command. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

## 6. NOTES

(This section contains information of a general or explanatory nature that may be helpful but is not mandatory.)

6.1 Intended use. The propellant described by this specification is intended for use as an fuel in rocket engines.

6.2 Acquisition requirements. Acquisition documents must specify the following:

- a. Title, number, and date of the specification.
- b. Issue of DoDISS to be cited in the solicitation, and, if required, the specific issue of individual documents referenced (see 2.2.1 and 2.3).
- c. Method of shipment, type and capacity of containers.
- d. Quantity by weight.
- e. When a different sampling plan is required (4.2).

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f. Packaging requirements (see 5.1).

6.3 Part or identifying number (PIN). The PIN to be used for propellant acquired to this specification is M27402.

6.4 Subject term (key word listing).

Fuel  
Hydrazine  
Propellant  
Rocket engine  
uns-dimethylhydrazine

6.5 Changes from previous issue. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extent of the changes.

Custodians

Navy - AS

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Review Activities

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Civil Agency Interest

NASA

(Project 9135-0141)